

Cellular Networking Perspectives

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Comments Welcome

We welcome comments on the contents and format of this newsletter, suggestions for future topics, corrections or additional information.

9-1-1 Joint Expert's Meeting

The TIA TR45 committee is organizing a Joint Expert's Meeting (JEM) on the subject of improved cellular 9-1-1 emergency service for the week of August 1, 1994. In our April issue we summarized some of the current problems with 9-1-1 service, notably the inability of cellular systems to pinpoint the location of a caller who dialed 9-1-1.

Mixed IS-41 Field Trials

Astronet and Alcatel-SEL will soon be engaged in the first mixed IS-41 Rev. A/Rev. B trials, using TIA TSB-55 (in publication) for compatibility. We would like to know of any other trials like this that have occurred, or will be occurring. Check the IS-41 Rev. B Implementation report on Page 5 for an update on other IS-41 Rev. B trials.

New Copying Policy

The copying policy of *Cellular Networking Perspectives* was revised in March, 1994. Effective with each subscription renewal or new subscription, each subscriber will be entitled to make up to 10 copies of each issue within their company. Subscription rates to permit more than 10 copies are available upon request. Subscribers are welcome to make occasional copies for the purpose of recommending this newsletter to others within or outside their company.

Short Message Service Joint Expert's Meeting

A Joint Expert's Meeting (JEM) on Short Message Service was held on March 21-25, 1994, chaired by Steve Jones of NEC. This Service will allow text messages, such as phone numbers or stock quotes, to be displayed on cellular terminals. Standards are being developed by several TIA subcommittees: TR45.1 for analog cellular, TR45.2 to support roaming, TR45.3 for TDMA digital cellular and TR45.5 for CDMA digital cellular. The high level description will reside in TIA IS-53 Revision A, when published.

The major recommendations of the Short Message Service JEM were:

1. A revised high level ("Stage I") description for incorporation in the IS-53 Rev. A cellular features standard.
2. A clarification of the relationship between the HLR associated with a mobile and its Message Center (MC).
3. Broadcast short messages should be supported.
4. A preferred language indicator should be supported.
5. Terminals should be able to announce an incoming short message by ringing, vibrating or other methods.

This report is only in draft form, and has not yet been accepted by the TIA TR45 committee.

Inter-System Call Delivery, Part III: When Lawyers Design Systems

In Part II of this series on cellular inter-system call delivery we described the complications that call forwarding and other features cause for call delivery. But if technical folks can make life difficult when trying to make systems more attractive to customers, you can imagine what the US Department of Justice (DOJ) can do! Well, imagine no longer. First we will describe what the DOJ has to do with phone calls, and then describe the ramifications for call delivery, including why customers of the cellular subsidiaries of the Regional Bell Operating Companies miss out on features that customers of other cellular carriers enjoy.

The AT&T Divestiture and Call Delivery

When the AT&T monopoly was dismantled in 1982 the seven Regional Bell Operating Companies (RBOCs) were given a regional monopoly on local phone service, but in return were restricted from providing long distance service and were required to provide equal access for their customers to the long distance carrier of their choice. These restrictions were part of the DOJ's Modified Final Judgment on the RBOC's, and are known as "MFJ Restrictions".

Cellular, then in its infancy, was, for no apparent reason, given to the RBOC's resulting in MFJ restrictions applying to their cellular subsidiaries. This is one of the reasons why Pacific Bell recently split, to allow "AirTouch" to compete in the cellular industry unencumbered by MFJ restrictions. The other reason is to allow Pacific Bell to participate in PCS where carriers contaminated by cellular licenses are discriminated against instead of the RBOC's. But that is another story.

Equal Access Requirements

Equal Access ensures that the RBOC's treat all long distance carriers equally by giving customers the same ease of access to any carrier that they might choose. Because inter-system call

delivery usually requires a long distance call to connect the calling party to the cellular system that the roamer is visiting in, the carrier preferred by the roamer must be used when the originating MSC routes a call to this roamer using a TLDN (see Part I of this series for more details). The identification of each subscriber's Preferred Inter-exchange Carrier (PIC) is stored at the HLR and transmitted to the originating system in the response to an IS-41 LocationRequest message, along with the TLDN.

Difficulties can arise when the long distance carrier is not available, or when no long distance carrier has been chosen by the roamer. There are various interpretations of the rules in these cases, including having the originating MSC pick a single default carrier or randomly distributing such calls to all connected inter-exchange carriers in turn.

Long Distance Prohibitions

While Equal Access requirements make life more complicated for cellular operators, at least the customer receives the benefit of a choice of competing long distance carriers. The MFJ rule against providing long distance service also restricts the type of information that may be exchanged between the home and visited systems when they are in different local calling areas (known as LATA's). These restrictions have been interpreted by the DOJ to redirection of calls to busy or unavailable roamers illegal. There are some complicated ways to limit the loss of voice mail services, which will also be described.

Basic call delivery, as described in Part I of this series, requires the transmission of an IS-41 RoutingRequest message from the Home Location Register (HLR) to the Visitor Location Register (VLR) and the visited MSC (MSC-V). The response to this message contains a Temporary Local Directory Number (TLDN) that can be used to route a call from the originating system to MSC-V through the wireline telephone network. Provided the call is delivered using the roamer's Preferred Inter-Exchange Carrier (PIC) this does not violate any MFJ restrictions.

However, the response to a Routing-Request may contain not a TLDN but a

status indicating why the mobile cannot be reached. This information is essential for forwarding incoming calls to voice mail when a roamer is busy or their phone is turned off (described in Part II of this series, April 1994). The DOJ, however, has ruled that transmission of the current status of a phone (i.e. busy, did not respond to page or did not answer) across a LATA boundary constitutes Interexchange Telecommunications Service (i.e. Long Distance Service) and is illegal. In this case a TLDN must be returned, the incoming call will be routed to MSC-V and then to busy tone. This scenario is illustrated in Figure 1.

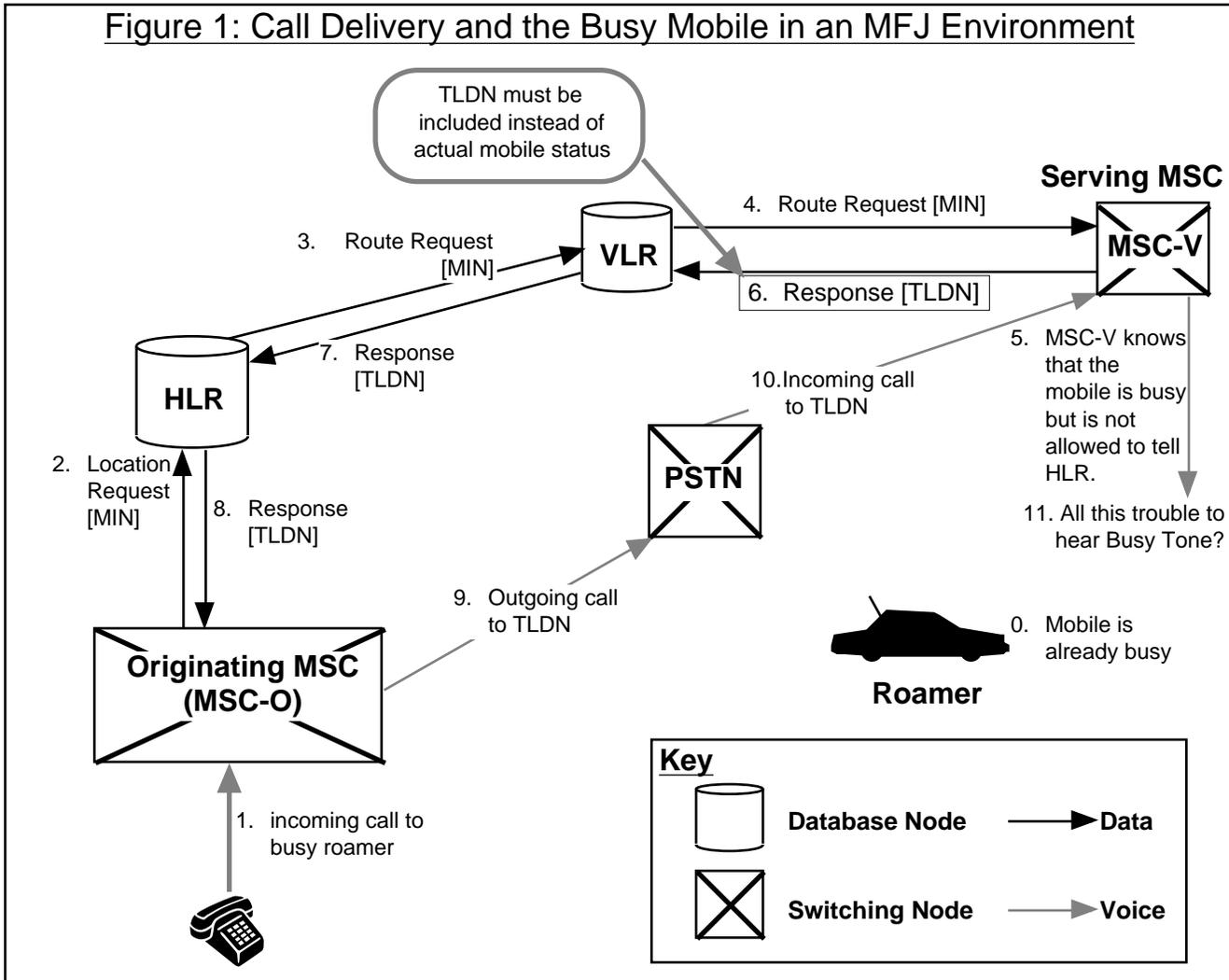
The result of this complicated scenario is that the calling party has no way to leave a message or to reach an alternate destination and the roamer has no indication that they lost a call. And, because the call was not answered, none of the telecommunications carriers involved will receive any revenue for the call, not even the Inter-Exchange carriers that want this restriction to be maintained!! This illustrates the principal that in a fight how much you hurt the opponent is more important than how much you get hurt yourself.

Mitigation of Roamer Status Transfer Restriction

The impact of the restriction on carrying roamer status information across a LATA boundary can be mitigated for some call delivery scenarios, for phones that register correctly (and not all do), by recognizing that the MFJ prohibition is only against transmitting "real-time" status of a mobile. If a mobile is determined through a lack of activity over a period of time to be inactive, this information *can* be transmitted across a LATA boundary. This approach to mitigating the impact of the restriction requires the following actions:

1. Setting up base station parameters to force all mobiles to register at regular intervals (e.g. hourly). This requires regular and coordinated increments of the EIA/TIA/553 REGID parameter transmitted by each base station.
2. Recording the time of the most recent access (origination, regis-

Figure 1: Call Delivery and the Busy Mobile in an MFJ Environment



tration or page response) by every mobile.

3. Ensuring that each VLR/MSC-V responds to an incoming Routing-Request message from an HLR with the "Inactive" indication when the "last access time" indicates that the mobile has missed at least one registration interval. Alternatively, the VLR/MSC-V can use an IS-41 CSS-Inactive message to transmit this information, although this method is somewhat less efficient.
4. Ensuring that the HLR passes the information to the originating MSC so that it redirects incoming calls to "Inactive" mobiles to voice mail.

This "solution" does not prevent the loss of voice mail. It does not work for busy roamers, nor for mobiles that have been inactive less than the reregistration interval.

To Be Continued...

In Part IV of this series on inter-system call delivery we will discuss several optimizations that can make inter-system call delivery more efficient:

- a. Eliminating unnecessary long distance legs using "Gateway" systems.
- b. Paging before routing, and even ringing while routing.
- c. Monitoring mobile activity to eliminate unnecessary IS-41 inter-system messaging.

We will also discuss the problems that must be overcome before these optimizations can be implemented. And, of course, MFJ restrictions will be among those problems!

Guest's Corner: PCS

Our undercover TR46 PCS observer has some caustic comments to make about the recent revitalization of interest in IS-41.

The GSM camp and the IS-41 camps inside TIA committee TR46 both have their constituency, which are now abiding by an uneasy truce. Given the lack of action by the FCC on spectrum licensing, the recent change in heart of some potential PCS providers from GSM to IS-41 for a network protocol is strictly due to a change in the economics of the situation. The longer the FCC delays licensing the more time IS-41 supporters have to enhance IS-41 MAP. At one time some GSM proponents did not support interworking, interoperability or interconnection of GSM systems with non-

GSM systems. Only AT&T and Bell Atlantic were actively supporting IS-41 and compatibility with the existing North American communications network.

Now that TR46 has begun discussing emergency services, national emergency response, and law enforcement needs the GSM supporters are doing double takes.

Many of the proponents of Personal Communications Services (PCS) have long been saying that it will be different than cellular. They said that PCS involved the use of a personal telephone number, a number assigned to a person and not a phone. That is what made PCS what it is and the lack of a personal number is what made cellular what it is. It is true that current cellular implementations provide only terminal mobility, however, to believe that cellular carriers will not implement personal numbering (personal mobility) is totally unrealistic. If one believes that cellular carriers can provide PCS (i.e. personal numbering) in the 800 Mhz band then the only difference between PCS providers and cellular carriers is spectrum and price. And, what technology is available to make 1800 MHz systems cheaper than cellular, that cannot also be used by cellular? The PCS industry has, in reality, wasted the last two years reinventing the cellular wheel under the guise of PCS.

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TR-45.2 Standards Update: IS-41 Test Plan Approved for Publication

TR-45.2 has approved an IS-41 Revision B test plan for publication, pending

approval of editing changes. This TSB provides a high level test plan to the industry for not only Revision B of IS-41, but also TSB-51 (authentication, signaling message encryption and voice encryption for dual-mode TDMA terminals) and IS-53 Revision 0 features (3 way calls, call waiting and call forwarding). At the very last minute TR-45.2 decided to publish this document as Revision A to TSB-56 (the IS-41 Rev. A test plan) instead of a distinct document (TSB-42 Rev. 0).

The status of the major outstanding TR-45.2 projects follows:

Border Cell TSB (TSB-65, SP-2910) • Published in April, 1994.

IS-41 Rev. A Compatibility (TSB-55, SP-3063) • Being published.

IS-41 Rev. B Test Plan (TSB-56-A, SP-2978) • Approved for publication as TSB-56 Revision A (not TSB-42 as originally planned) pending approval of editorial changes based on ballot comments from Ericsson, Motorola, Synacom and Qualcomm.

IS-41 Rev. B Technical Notes (TSB-41, PN-2985) • Will resolve many ambiguities in IS-41 Rev. B that have been detected as incompatibilities between different implementations of IS-41 Rev. A. The disagreement over the interpretation of MSCID has been resolved, therefore TSB-41 will likely be approved for publication at the May TR45.2 meeting.

Cellular Dialing Plan (IS-52 Rev. A, PN-3166) • A draft of IS-52 will be considered for elevation to baseline status at the May TR-45.2 meeting. Balloting was scheduled for April, 1994, but will be deferred until agreement is reached on the baseline document.

Subscriber Features (IS-53 Rev. A, PN-2977) • Descriptions of all features are out for Verification and Validation (V&V). Balloting is scheduled for May, 1994.

IS-41 Revision C (PN-2991) • A baseline draft of this major revision to IS-41 has been developed. Most of the remaining work will be to incorporate the twenty new IS-53 Rev. A features

and to support extended 15 digit mobile identifications to facilitate international roaming. Other work includes possibly major restructuring and incorporating enhancements to the previously published TSB-51 and not yet published TSB-55. **Balloting is scheduled for July, 1994.**

International Applications (TSB-29 Rev. B, PN-3173) •

TR-45.2 is studying several problems with international use of AMPS cellular. This is a low priority project and will be **completed in 1995.**

Online Call Record Transfer (IS-124 Rev. A, PN-3293) •

TR-45.2 recently opened this new project number to revise the just published "DMH" standard for the online transfer of call records for billing, fraud and other purposes. This activity is a low priority and will be **completed in 1995.**

Back Issues Available

Back issues are available from July, 1992 to the present. Articles in some of our older issues are:

July, 1992

Introduction to the TIA cellular standards setting committees.

August, 1992

Authentication, Validation and Voice Privacy.

September, 1992

North American Numbering Plan changes, part I.

October, 1992

North American Numbering Plan changes, part II.

November, 1992

Inter-System Handoff, part I - Handoff Forward/Back.

December, 1992

Inter-System Handoff, part II - Path Minimization.

January, 1993

Inter-System Handoff, part III - Feature Interactions

February, 1993

Inter-System Handoff, part IV - New Air Interfaces. IS-41 Rev. 0 Field Trials.

March, 1993

Wireless '93 in review.

The price of a back issue is, by mail or fax is:

| | |
|---------|-----------------|
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Status of IS-41 Rev. B Implementation

Cellular Networking Perspectives

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| Vendor1 | Vendor2 | Status | Date | Type | Location |
|-------------|---|-------------|-------|----------|-----------------------------------|
| Alcatel-SEL | Astronet | Lab Trial | 04/94 | H V-D S | Mobile, AL (BellSouth) |
| | <i>(Note: Astronet is using IS-41 Rev. A with TIA TSB-55 for compatibility)</i> | | | | |
| | AT&T | Lab Trial | 04/94 | H+V-D S | Orlando, Florida (BellSouth) |
| | EDS PCD | Field Trial | 04/94 | - V-D S | Mobile, Alabama (BellSouth) |
| | GTE TSI | Lab Trial | 01/94 | - V-D S | Mobile, Alabama (BellSouth) |
| | Motorola | Lab Trial | 04/94 | H V-D S | Jacksonville, Florida (BellSouth) |
| Astronet | | Development | | | |
| AT&T | Alcatel-SEL | Lab Trial | 04/94 | H+V-D S | Ft. Lauderdale/Miami (BellSouth) |
| | GTE TSI | Lab Trial | 2Q/94 | - V-DXS | Philadelphia (BAM) |
| | NEC | Lab Trial | TBD | H V-D S | Brazil |
| | NTI | Lab Trial | TBD | H+V-DX T | location not announced |
| EDS PCD | Alcatel-SEL | Field Trial | 04/94 | - V-D S | Mobile, Alabama (BellSouth) |
| Ericsson | Motorola | Field Trial | 2Q/94 | H V-D S | location not announced |
| | NTI | Planning | | H VAD ST | location not announced |
| GTE TSI | Alcatel-SEL | Lab Trial | 01/94 | - V-D S | Mobile, Alabama (BellSouth) |
| | AT&T | Field Trial | 2Q/94 | - V-DXS | Philadelphia (BAM) |
| Motorola | Alcatel-SEL | Lab Trial | 04/94 | H V-D S | Jacksonville (BellSouth) |
| | Ericsson | Field Trial | 2Q/94 | H V-D S | Piscataway (Comcast) |
| | NTI | Field Trial | 1Q/94 | H V-DXS | location not announced |
| NEC | AT&T | Lab Trial | TBD | H V-D S | Brazil |
| NTI | AT&T | Lab Trial | TBD | H V-DX T | Windsor (Bell Mobility) |
| | Ericsson | Planning | | H VAD ST | Ft. Myers (Palmer) |
| | Motorola | Field Trial | 1Q/94 | H V-DXS | location not announced |

Explanation: Status: Development, Planning, Lab Trial, Field Trial or Commercial

Completion: Date of actual or expected start of listed phase of testing.

Type: Type of test:

H Includes handoff forward and back

H+ Also includes path minimization and/or flash handling

V Includes validation

A Includes authentication (TSB-51)

D Includes call delivery

X Uses X.25 datalink protocol

S Uses ANSI SS7 datalink protocol

C Uses CCITT SS7 datalink protocol

T Uses TDMA digital mobiles (IS-54)

W Uses Wideband (CDMA) digital mobiles (IS-95)

Location: Location of test and carrier. Usually listed for first trial only.